J. Raptor Res. 35(3):214–220

HABITAT USE, POPULATION DENSITY, AND HOME RANGE OF ELF OWLS (*MICRATHENE WHITNEYI*) AT SANTA ANA NATIONAL WILDLIFE REFUGE, TEXAS

CHRISTOPHER M. GAMEL[1] AND TIMOTHY BRUSH
Department of Biology, University of Texas–Pan American, Edinburg, TX 78539 U.S.A.

ABSTRACT.—We collected data on the habitat use, home range size, and population density of the Elf Owl (*Micrathene whitneyi idonea*) in the Santa Ana National Wildlife refuge (SANWR) Lower Rio Grande Valley, Texas. Fourteen nocturnal surveys in 1995 and 1996 indicated that Elf Owls used chaparral habitat (92%) more than riparian woodlands (8%). Habitats used had high foliage densities (greatest density = 2.5–3.0 m) with partial canopies ($\bar{x}$ = 3.8 ± 0.36 m [±SE] and semi-open understories (greatest density <1 m). Unused chaparral habitat lacked high canopy coverage and had a denser understory, while riparian woodlands had greater canopy heights ($\bar{x}$ = 5.25 m) and open understories. Home range size determined by radiotelemetry averaged 1.05 ± 0.33 ha (range = 0.24–2.60, N = 9). We estimated the maximum potential population size in SANWR to be 802 Elf Owls, assuming a home range size of 1.05 ha per breeding pair and saturation of preferred habitat.

KEY WORDS: *Elf Owl*; Micrathene whitneyi; *home range*; *habitat selection*; *chaparral*; *Santa Ana National Wildlife Refuge*; *Texas*.

Uso de habitat, densidad poblacional y rango de hogar de *Micrathene whitneyi* en el Refugio Nacional de Vida Silvestre de Santa Ana, Texas

RESÚMEN.—Colectamos datos sobre el uso de hábitat, tamaño del rango de hogar y densidad poblacional de *Micrathene whitneyi idónea* en el Refugio Nacional de Vida Silvestre de Santa Ana en el valle bajo del Rio Grande en Texas. (RNVSSA) Catorce monitoreos nocturnos hechos en 1995 y 1996 indicaron que *Micrathene whitneyi* utilizó el hábitat de chaparral (92%) mas que los bosques ribereños (8%). Los hábitat utilizados tenían densidades de follaje mayores (mayores densidades = 2.5–3.0 m, con doseles parciales ($\bar{x}$ = 3.8 ± 0.36 m ± SE) y con sotobosques semiabiertos (con una densidad de < 1 m) . El hábitat de chaparral no utilizado no tuvo una cobertura de dosel alta con una densidad mayor en el sotobosque, mientras que los bosques ribereños tuvieron una mayor altura del dosel ($\bar{x}$ = 5.25 m) y un sotobosque abierto. El tamaño del rango de hogar fue determinado por el promedio de los resultados de telemetría 1.05 ± 0.33 (rango = 0.24–2.60 ha, N = 9) . Estimamos un tamaño potencial máximo de población en el RNVSSA de 802 búhos enanos, asumiendo un rango de hogar de 1.05 ha por pareja reproductiva y una saturación del hábitat preferido.

[Traducción de César Márquez]

The Elf Owl (*Micrathene whitneyi*) extends from the southwestern United States to southern Mexico. The subspecies *M. w. whitneyi* is the most extensively studied of the four subspecies breeding in southern Arizona (Ligon 1968, Goad and Mannan 1987), extreme southeastern California (Rosenberg et al. 1991), western New Mexico, the Big Bend region of Texas (Van Tyne and Sutton 1937), and into western Mexico (Ligon 1968, Stacey et al. 1983). *M. w. idonea* breeds along the Texas-Mexico border (Wauer 1971) and patchily in Tamaulipas (F. Gehlbach pers. comm.). *M. w. whitneyi* occurs in a variety of habitat types including evergreen woodlands, Sinaloan deciduous forests (Ligon 1968), and Sonoran desert in association with saguaro cactus (*Cereus giganteus*, Goad and Mannan 1987). Because the habitats in southern Texas differ drastically, habitat requirements of *M. w. idonea* are probably different.

The Elf Owl is a breeding resident in the Lower Rio Grande Valley (LRGV; Cameron, Willacy, Hidalgo, and Starr counties) of south Texas (Oberholser 1974, Gehlbach 1987). The LRGV delta is

[1] Present address: Marine Mammal Physiology Laboratory, 5007 Ave. U, Texas A & M University, Fort Crockett, Galveston, TX 77551 U.S.A.

the alluvial floodplain of the Rio Grande as it flows toward the Gulf of Mexico. Much of the vegetation occurring in the area is adapted to the annual flooding of the river system. Since its completion in 1953, Falcon Dam has affected the flora and fauna in the floodplain. Today, seasonal flooding of the Rio Grande rarely occurs and there has been a gradual change from riparian woodlands to chaparral communities, locally known as Tamaulipan thornscrub (Vora 1990). The Elf Owl was first documented in the LRGV in 1889 (Sennett 1889). For the next 70 yr, it was believed to be extirpated from the LRGV, until it was rediscovered in 1960 by James and Hayse (1963) who found it in the western portion of the LRGV in Starr and western Hidalgo counties. Oberholser (1974) found two fledglings in Santa Ana National Wildlife Refuge (SANWR) in 1965 and Gehlbach (1987) found them nesting at the edge of evergreen forests in SANWR from 1973–78 suggesting that the species was spreading east.

Since 1920 there has been an overall shift in the habitat composition at SANWR so that it now consists mainly of chaparral (Vora 1990). Today, riparian woodlands cover only about 25% of SANWR (E. Hopson pers. comm.). The change in habitat has been directly attributed to the absence of seasonal flooding of the Rio Grande (Ramirez 1986, Vora 1990), but few studies have looked at subsequent changes in the plant and bird communities. The objectives of this study were to describe patterns of habitat use, home range size, and population density of the *M. w. idonea* subspecies of the Elf Owl in the wildlife refuge.

STUDY AREA AND METHODS

The study area consisted of 842 ha of native chaparral and other wooded habitat in southern Hidalgo County, TX. The refuge encompasses the largest remaining tracts of chaparral and riparian woodland in the LRGV (Vora 1990). A tour road, 10 km in length, and an extensive trail system cut through both vegetative types and provided a route for surveying the area for Elf Owls.

We conducted nocturnal surveys during the breeding seasons (late March–early August) of 1995 and 1996 to determine relative owl densities and second-order habitat use. The survey route had 7.26 km of chaparral (67%) and 3.74 km of riparian woodland (33%) in the 1995 field season. The survey route was increased in 1996 increasing the amount of chaparral and riparian woodland to 7.32 km (60%) and 4.88 km (40%), respectively. Surveys covered 68% of SANWR.

Surveys were made on foot while listening for owl responses to recorded playbacks. They were conducted once every three weeks to determine if there was seasonal variation in the density and habitat use of the owls. The direction of searches was reversed on four occasions to reduce potential biases.

Along the routes, we broadcast tape-recorded calls of Elf Owls every 300 m and listened for 1 min for spontaneously calling Elf Owls, following which the recorded call was played two more times for about 15 sec (6 calls) Each presentation of calls was followed by 1 min of listening and a search of the immediate vicinity with a hand-held flashlight for owls. The estimated locations of all vocalizing owls were recorded on 7.5 min topographic maps of the area (Gamel 1997).

We captured Elf Owls in mist nets. Two to four, 3 × 13 m mist nets were set up shortly after sunset in areas where Elf Owls had been heard calling. Continuous broadcasting of a recorded Elf Owl call was used to lure owls into the mist nets. Owls that did not appear to be overly stressed were fitted with 1.2–1.4 g radio transmitters (Wildlife Materials, Inc., Carbondale, IL U.S.A.). In 1995, four transmitters were attached with a backpack style cross-chest harness. In 1996, five transmitters were directly attached to the dorsal feathers along the spine, as per Warnock and Warnock (1993).

Owl locations were determined by triangulation with a hand-held receiver (TRX-10S, Wildlife Materials, Inc , Carbondale, IL U.S.A.) and a three element Yagi antenna. Bearings were taken by a single individual, with readings taken from pre-established stations. Tracking usually began within one hour of sunset and ranged from 1–5 hr in length. Tracking was repeated several times over a month period until either 30 locations were recorded for each owl, the transmitter battery failed, or the owl left the area. Area/observation curves indicated 30 locations were adequate to show movement patterns of the Elf Owls over a month-long portion of the breeding season Individuals were located at 30 min intervals and all bearings for a single location were collected within a 10-min period to reduce error. Home range sizes were calculated with the TELEM88 program (Coleman 1989) using a 100% minimum convex polygon. No individuals were followed in both 1995 and 1996, as no owls were recaptured

We identified three habitat categories: chaparral habitat utilized by Elf Owls (CWO), chaparral habitat not utilized by Elf Owls (CWNO), and riparian woodlands. An analysis of the vegetation in each habitat was conducted using a point-quarter sampling method (Brower et al. 1977). Sample points were placed at 10-m intervals along a 100-m transect. Within each habitat, three transects were established yielding a total of 33 sample points. In the CWNO and in the riparian woodlands, starting locations and directions for all transects were chosen randomly. Within the CWO, transects were established within the home range of three randomly picked, radio-tracked owls. At each sample point, measurements were taken on the nearest woody species ≥2 m in height in each quadrant. For each individual woody species, point-to-plant distance, diameter at breast height (DBH), and individual tree canopy coverage (at the widest point of coverage) were recorded. Canopy height was measured and % canopy cover was estimated with a densiometer. Foliage density was quantified using a modified version of Mills et al. (1991) by marking a 3-m extending pole at 0.5 m intervals along the entire length. When fully extended and held at arm's length above the head, total height cov-

Table 1. Comparison of the mean structural composition of the vegetation among habitats in the Santa Ana National Wildlife Refuge, Texas. Characteristics included are tree density, individual tree cover, diameter at breast height (DBH), % canopy cover, and canopy height. An asterisk (*) between two habitats indicates a significant different ($P < 0.05$).

CHARACTERISTIC	RIPARIAN WOODLAND		CHAPARRAL WITH OWLS		CHAPARRAL WITH NO OWLS
Tree density (m^2)	0.32 + 0.10		0.41 + 0.07		0.53 + 0.09
Tree cover (m)	4.07 + 0.27	*	3.35 + 0.22	*	2.61 + 0.15
DBH (cm)	12.12 + 1.16		13.04 + 1.55		11.96 + 1.59
% Canopy cover	67.70 + 0.06		55.20 + 0.06		40.00 + 0.06
Canopy height (m)	4.96 + 0.28	*	3.81 + 0.36		2.82 + 0.30

ered was 5.5 m. At each sample point, the pole was erected vertically and the number of plant touches were recorded per 0.5 m segment. Records included touches by all vegetative matter.

We used SPSS-X (SPSS, Inc., Chicago, IL U.S.A.) for statistical analyses. Results were considered significant when $P \leq 0.05$. Means are accompanied by standard errors on all measurements. A chi-square test was used to determine differences in habitat use between the 1995 and 1996 field seasons. For each survey, the expected distribution of Elf Owls reflected the area covered in riparian woodlands and chaparral. A Sorensen's coefficient of community similarity was calculated to compare the similarity of species between different habitat types. A one-way analysis of variance (ANOVA) was used to verify any observed differences between the three habitats for the variables quantified in the vegetation transects. In cases where a significant difference was found, a Tukey HSD test was used to identify which habitats differed significantly. In all cases, CWO was compared to both CWNO and riparian woodlands.

RESULTS

We recorded a total of 145 Elf Owl locations. Significantly more locations were in chaparral ($N = 134$) than in riparian ($N = 11$) habitats in 1995 ($\chi^2 = 52.408$, df = 1, $P < 0.001$) and 1996 ($\chi^2 = 51.946$, df = 1, $P < 0.001$). The three transects within riparian woodlands included 13 tree species, of which anacua (*Ehretia anacua*), sugar hackberry (*Celtis laevigata*), and cedar elm (*Ulmus crassifolia*) dominated. CWO included 12 species of trees, with la coma (*Bumelia celastrina*), Texas persimmon (*Diospyros texana*), and spiny hackberry (*Celtis pallida*) the dominant species. CWNO included 16 tree species, with the dominant species being spiny hackberry, la coma, and guayacan (*Guaiacum angustifolium*). Despite the difference in species dominance, there was overlap in species presence between the different habitat types. A Sorensen's coefficient of community similarity showed riparian woodlands and CWO to be 67% similar, CWO and CWNO 79% similar, and riparian woodlands and CWNO 64% similar. Sorensen's coefficients comparing the transects in the CWO to each other indicated within-habitat dissimilarity to be as great as 26%.

Riparian woodlands had significantly greater canopy heights ($F = 10.219$, df = 2, $P < 0.001$; Table 1) and individual tree covers ($F = 11.425$, df = 2, $P < 0.001$) than CWO. Differences in tree density, DBH, and % canopy cover were not significant ($P > 0.05$). CWO had significantly greater individual tree cover ($F = 11.425$, df = 2, $P < 0.001$) than CWNO. Tree density, DBH, % canopy cover, and canopy height were not significantly different ($P > 0.05$). The vegetation in CWO was significantly denser at 2.50–3.00 m ($F = 3.281$, df = 2, $P = 0.042$; Fig. 1) than in riparian woodlands but, in riparian woodlands, the vegetation was significantly taller 5.00–5.50 m ($F = 6.275$, df = 2, $P = 0.003$). The vegetation in CWNO was denser than CWO ($F = 8.955$, df = 2, $P < 0.001$; Fig. 2) but the vegetation in CWO was significantly taller >5.50 m ($F = 14.145$, df = 2, $P < 0.001$).

Ten Elf Owls were captured in 1995 and seven in 1996 over the course of nearly 52 hr of mist net trapping. Of these, nine Elf Owls were instrumented with radio transmitters (4 in 1995 and 5 in 1996). Home range size ranged from 0.24–2.60 ha ($\bar{x} = 1.05 \pm 0.33$ ha). There was no correlation between number of locations per owl and home range size ($r = -0.292$, $P = 0.20$) but an owl with 30 locations had the smallest home range (0.24 ha). We did not find evidence of home range overlap.

DISCUSSION

Elf Owls made significantly greater use of chaparral habitat than riparian woodlands at SANWR. A total of 21 species of trees and shrubs were found along the nine vegetation transects and there was

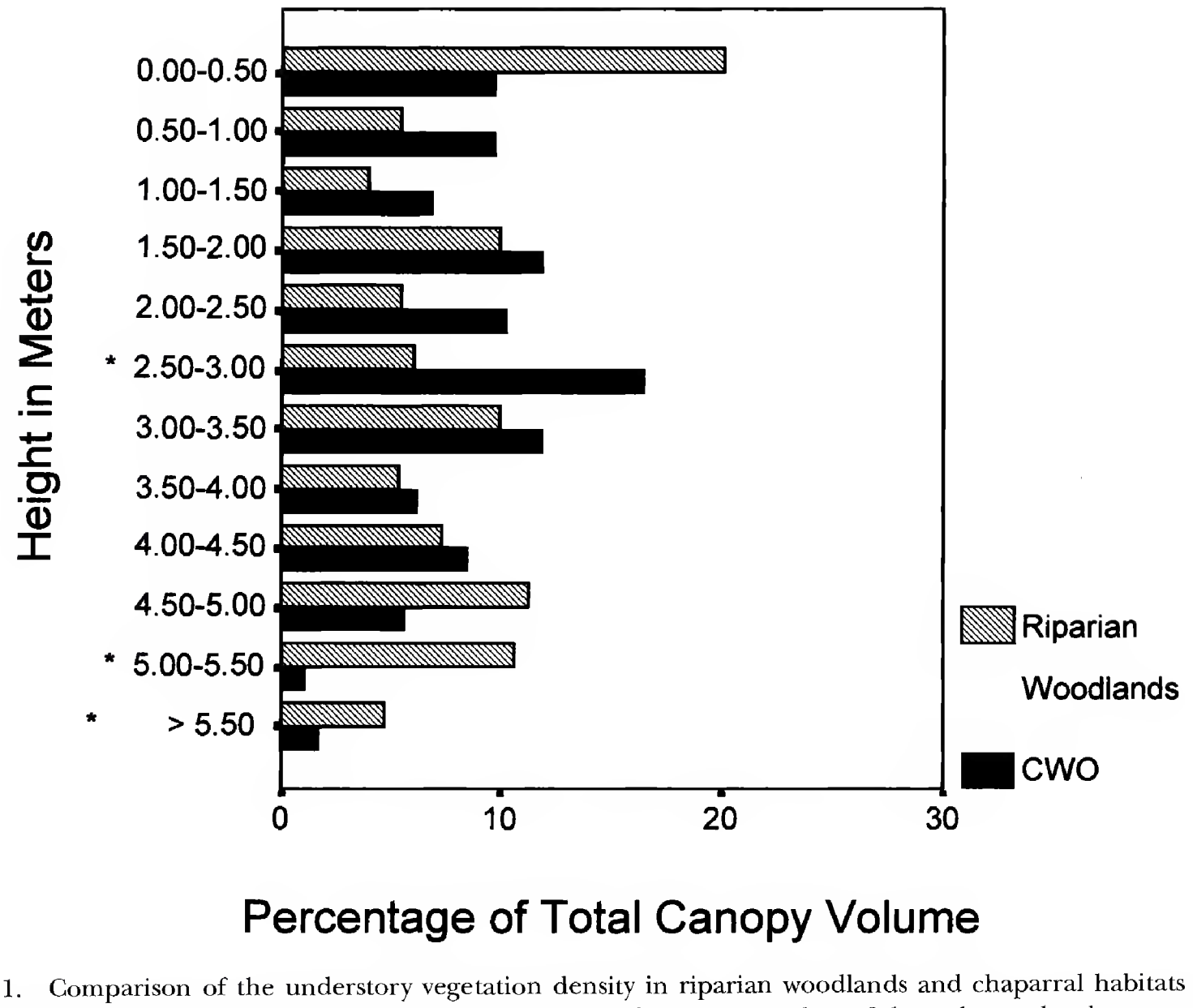

Figure 1. Comparison of the understory vegetation density in riparian woodlands and chaparral habitats used by Elf Owls. Percent of total canopy volume is calculated from the mean number of the pole touches by vegetation for each of the three transects at different heights. An asterisk (*) next to the pole height indicates a significant difference in density at that level. $N = 33$ in riparian woodlands and chaparral habitats used by Elf Owls.

a large degree of overlap in species among the transects. Still, Elf Owls occurred in one habitat more than the other. The diversity of habitats in which Elf Owls are known to reside (Ligon 1968, Schaeffer and Ehlers 1979, Goad and Mannan 1987) suggests that the presence, or absence, of particular woody plant species plays a role in habitat use.

The suitability of individual tree species for excavation by primary cavity nesters could also affect the distribution of secondary cavity nesters like the Elf Owl. This has been shown to be the case with *M. w. whitneyi* which tends to favor saguaro cacti as nest sites due to the abundance of Gila Woodpecker (*Melanerpes uropygialis*) and Gilded Flicker (*Colaptes chrysoides*) excavations (Goad and Mannan 1987). A similar dependence on primary cavity nesters has been documented in Flammulated Owls (*Otus flammeolus,* McCallum and Gehlbach 1988), Eastern Screech-Owls (*Otus asio,* Belthoff and Ritchison 1990), and Northern Spotted Owls (*Strix occidentalis occidentalis,* Bias and Gutierrez 1992).

While availability of cavities is often a limiting factor for secondary cavity nesters (Brawn and Balda 1988, Petty et al. 1994), such is likely not the case at SANWR, where primary cavity nesters are common (Carter 1986, Gehlbach 1994, Brush and Cantu 1998) and cavities (rot and woodpecker-excavated) are abundant throughout all three vegetative communities (T. Brush pers. obs.).

An analysis of the structural features of each community showed canopy height, individual tree cover, and understory density were important in the use of habitats by Elf Owls. Canopy height differed significantly between riparian woodlands and CWO with Elf Owls using the intermediate canopy heights found in CWO. The combination of a

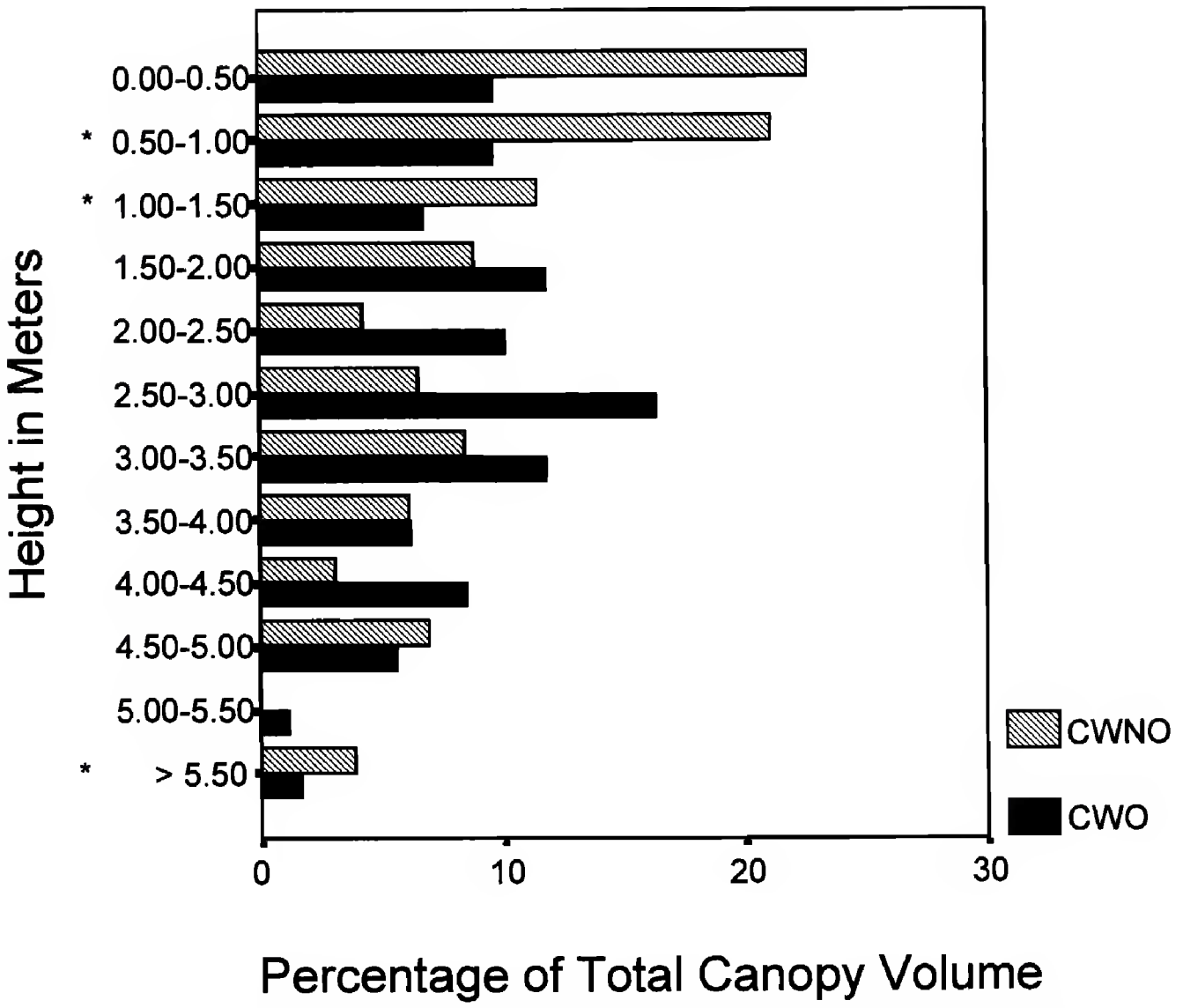

Figure 2. Comparison of the understory vegetation density in chaparral habitat used by Elf Owls and chaparral habitat not used by Elf Owls. Percentage of total canopy volume is a calculated from the mean number of the pole touches by vegetation for each of the three transects at different heights. An asterisk (*) next to the pole height indicates a significant difference in density at that level. $N = 33$ in chaparral habitat used by Elf Owls and chaparral habitat not used by Elf Owls.

higher canopy and large individual tree coverage causes a distinct, but partial, canopy to form in the CWO which is lacking in the CWNO.

Elf Owls in SANWR use habitat that consists of a distinct, but partial, canopy layer at about 4 m and a semi-open understory which is most dense at 2.50–3.00 m. They do not use areas that have no understory or have very dense understories and very high or low canopies. Flammulated Owls (McCallum and Gehlbach 1988) and Boreal Owls (*Aegolius funereus,* Norberg 1970), are known to dive steeply when leaving a perch, then level off and fly 1–2 m above the ground. Similar behavior occurs in the Elf Owl (F. Gehlbach pers. com.), and may thereby explain why it does not use chaparral habitat which contains a very dense understory. At the same time, some understory appears necessary, possibly to provide protection from predators or to maintain appropriate habitat for prey items. This might explain why they do not use relatively-open riparian woodlands. Alternately, Gehlbach (1987) suggested that competition might occur between the Elf Owl and Eastern Screech-Owl, a resident of riparian woodlands at SANWR.

Ligon (1968) mapped Elf Owl home ranges based on the locations of calling males estimated the size to be 0.3 ha. Our radio-telemetry data supports the observation that Elf Owls occupy small home ranges. Although our home range size of 1.05 ha was larger, six of the nine owls tracked used areas <0.6 ha. Of the three that occupied larger home ranges, one moved back and forth between two patches of chaparral habitat that were separated by a band of riparian woodland. While this riparian strip was included in the convex polygon, we observed no use of the area except as a corridor. Even the closest ecological equivalent owl species, the Flammulated Owl, maintains an average

home range size of 14.1 ha (Howie and Ritcey 1987), over 13 times as large. Prey abundance has been shown to strongly influence home range size of Eastern Screech-Owls (Belthoff et al. 1993) and Northern Spotted Owls (Carey et al. 1992). Eastern Screech-Owls in suburban settings maintain small home ranges of only 4–6 ha (Gehlbach 1994) compared to sizes ranging from 11.9–108 ha in other parts of North America (Johnsgard 1988, Belthoff et al. 1993, Gehlbach 1994). The small home range size we observed in Elf Owls may have been due to the insectivorous diet of the Elf Owls and the large numbers of insect prey in chaparral habitat.

Several authors have indicated that Elf Owls are territorial (Ligon 1968, Johnsgard 1988). The data we collected supported the notion that this owl actively defends territories. During nocturnal surveys, responding males tended to be spaced out rather then clumped close to each other. Also, no instrumented owls maintained overlapping home ranges. In contrast, both Ligon (1968) and Gehlbach (pers. comm.) observed home range overlap in Elf Owls in Arizona.

Based on our findings, we estimated the maximum population of Elf Owls that can be supported in SANWR. In making this estimate, we assumed a home range size of 1.05 ha, all of the available habitat is occupied, all home ranges are occupied by a breeding pair, and owls do not use habitat that is not suitable for them. Based on our estimation that there was 421 ha of suitable habitat in SANWR, we extrapolated that a maximum of 401 pairs, or 802 owls, could be supported in SANWR indicating that that current population is substantially smaller than the maximum that can be supported.

Wildlife management policies in the LRGV are currently focused on reducing the negative impact that halting of annual flooding has had on riparian woodlands. Recent programs at SANWR involving artificial flooding have the potential of halting, even reversing, the habitat transition from riparian woodlands to chaparral that has been underway since the completion of Falcon Dam in 1953. Some species have apparently benefitted from the increased availability of chaparral communities. The Elf Owl, in particular, has gone from a state of possible near-extirpation to maintaining a substantial population since 1963.

Acknowledgments

We gratefully acknowledge E. Hopson, F. Judd, and R. Lonard for their guidance throughout this study. Field assistance was provided by N. Adame, D. Ake, C. Castillo, C. Rupert, J. Rupert, V. Varela, and R. Zamora. G. Proudfoot provided technical advice. We also thank C. Crocker-Bedford, F. Gehlbach, S. Henry, R.W. Mannan, and P Stacey for suggestions on an earlier draft of the manuscript. Funds were provided by the University of Texas–Pan American Faculty Research Grant number 119123 All captures and banding were conducted under federal bird-banding permit number 22544.

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Received 23 June 2000; accepted 20 April 2001